REMARKS

Favorable reconsideration of this application is respectfully requested.

Claims 1-3, 5-17, 19-24, and 26-28 are pending in this application. Claims 4, 18, and 25 were previously canceled without prejudice or disclaimer. Claims 1-3, 5-17, 19-24, and 26-28 have been amended without the introduction of any new matter.

In this last respect, note that the repeated movement of at least one of lenses 12 and 14 is described in the specification, for example, at page 22, lines 2-17 relative to the plurality of movement cycles illustrated there of the servo offset value variations of FIG. 6A. The operation of adjusting the lens positions over a plurality of cycles of this repeated movement until the amplitudes A1 and A2 of FIG. 6B and/or amplitudes B1 and B2 shown in the right hand side of FIG. 7, for example, are equal is further clear from the description of page 22, lines 15-23, of the specification, for example, as well as these showings of FIG. 7 of adjustments if A1<A2 or for A>A2 and the corresponding B1 and B2 processing. The requirement for the repeated movement to the two opposite end positions shown as t1 and t2 in FIG. 6A occurring over a same time period comes from the fact that sine waves of constant frequency f1 and f2 are applied to drive the actuators 13 and 15, note the specification at page 25, lines 3-6, for example.

The outstanding Office Action presents a rejection of Claims 1-3, 5-7, 15-17, 19-24, and 26-28 under the first and second paragraphs of 35 U.S.C. §112, a rejection of Claims 1, 5, 15, 19, 22, and 26 under 35 U.S.C. §102(e) as being anticipated by <u>Maeda et al</u> (U.S. Patent No. 6,005,834, <u>Maeda</u>), and a rejection of Claims 2, 3, 16, 17, 23, and 24 as being unpatentable over <u>Maeda</u> in view of <u>Funada</u> (U.S. Patent No. 4,730,294) under 35 U.S.C. §103(a), and a rejection

of Claims 6, 7, 20, 21, 27, and 28 as being unpatentable over Maeda in view of Sugiyama et al. (U.S. Patent No. 4,352,981, Sugiyama).

Initially, Applicants gratefully acknowledge the indication in the outstanding Office Action that Claims 8-14 are allowable over the prior art.

Turning to the rejection of Claims 1-3, 5-7, 15-17, 19-24, and 26-28 under the first paragraphs of 35 U.S.C. §112, it is believed that this rejection is moot in view of the present amendment that deletes the language objected to in Claims 1, 15, and 22. This deletion has been made strictly to advance prosecution as clear support for this language appeared in original Claims 4, 18, and 25 and the original claims are to be considered to be part of the originals disclosure, see In re Koller, 204 USPQ 702 (CCPA 1980).

The rejection of Claims 1-3, 5-7, 15-17, 19-24, and 26-28 under the second paragraphs of 35 U.S.C. §112 is also believed to be moot as the objected to "cyclically moving" language of Claims 1, 15, and 22 has been replaced by the above-noted language describing how the movement of least one lens (two in Claim 15) is repeated in opposite directions along an optical axis to opposite end positions respectively closer to and further from the recording medium. As was further noted above, this repeated movement is described in the specification at page 22, lines 2-17 relative to the plurality of movement cycles illustrated relative to the focus servo offset value variations of FIG. 6A, for example. The operation of adjusting the lens positions over a plurality of cycles of this repeated movement until the amplitudes A1 and A2 of FIG. 6B are equal is further clear from the above-noted description of page 22, lines 15-23, of the specification, for example, as well as the above-noted showings of FIG. 7 of adjustments if A1<A2 or for A1>A2 as well as similar B1 and B2 processing. As also noted above, the

requirement for the repeated movement to the two end positions shown as t1 and t2 in FIG. 6A to be done in equal time periods comes from the fact that sine waves of constant frequencies (f1 and f2) are applied to drive the two different lens actuators.

It is respectfully submitted that the claimed movement of one or both of the lenses 12 and 14 would be clear to those having ordinary skill in the art and the rejection of Claims 1-3, 5-7, 15-17, 19-24, and 26-28 under the second paragraphs of 35 U.S.C. §112 should, accordingly be withdrawn.

Just as the artisan would understand the required lens movement of Claims 1, 15, and 22 to be repeated in opposite directions along an optical axis between opposite end positions respectively closer to and further from the recording medium in equal time periods, that artisan would also understand there is no such lens movement taught for the Maeda focusing servo system.

In this last reqard, the Action offers col. 5, lines 10-28 of Maeda as teaching the moving means of Claim 1 and the similar moving step of Claim 22. However, col. 5, lines 10-19 of Maeda relate to tracking servo movements that are not along any lens optical axis as such tracking movements must be made parallel to the plane of the record medium surface that is at a right angle to the optical axis because this is the surface having the record tracks. Moreover, subparagraph (b) at the top of page 3 of the outstanding Action is not understood as it appears to equate such tracking movements perpendicular to the optical axis to movements upward and downward along the optical axis.

While col. 5, lines 20-28 of Maeda at least relate to a focus servo for moving a lens along its optical axis, instead of perpendicular to it, there is no disclosure here or elsewhere in

Maeda teaching or suggesting the moving means of Claim 1, the two actuators of Claim 15, or the moving step of Claim 22. This is because Maeda does not teach or suggest the claimed repeatedly moving of at least one of two lenses in opposite directions along a common optical axis between end positions respectively closer to and further from the recording medium, much less that each repeated lens movement will take an equal time period.

The bottom of page 2 of the outstanding Action has improperly misinterpreted the teachings of Maeda in several respects. The first misinterpretation is that Maeda "lens group 36 and 37 move in a cyclic motion similar to Applicant's." Claims 1, 15, and 22 are specific to a repeated movement that must be between two end positions that are respectively closer to and further from the recording medium, with all of these movements taking the same time. There is no way of knowing the lens movements of Maeda resulting from the focus servo because the record medium of Maeda could produce different changes to the spacing between the lens and the record medium. Since surface imperfections of different record medium will be different, the movements of the lens by the focus servo cannot be known.

The outstanding Action is, thus, wrong in assuming that focus servos follow pit deviations from the recording medium surface instead of keeping the record surface with these pits in a focused state. See the pages 6-7 description of the focus correcting servo for CD discs in the article of Professor Kuhn attached hereto. Further note that the manner of reading the CD is based on the read laser wavelength and the depth of the pit being $\lambda/4$ of that wavelength so that the presence of a pit produces destructive interference. See section C ("Reading the Pits") at pages 4-5 of the Kuhn article.

Instead of the outstanding Action explaining where the teachings of the servo focus

control causing the lens to move back and forth along the optical axis because of the variations in depth of the pits appear in Maeda, the outstanding Action (at the bottom of page 2) simply assumes without any basis that "during a focusing operation, Maeda's lens 36 or 37 is driven according to the pit structure on the substrate." This is not at all similar to the synchronization feature of page 23 of the specification as the sine waves driving the actuators are separate drive signals that are synchronized by the pit signals, not pit up and down deviations. As noted in the specification (page 17, discussing Fig. 3), the focus error signal is not based on following the pit depressions.

Accordingly, the PTO is again called upon to meet the court obligation imposed by In re Rijckaert, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993) and to explain where in Maeda the "explicit or implicit teaching or suggestion" appears that teaches the above-noted "focusing operation" in which "Maeda's lens 36 or 37 is driven according to the pit structure on the substrate." This is further required because the PTO contradicts itself by asserting (in the paragraph bridging pages 14 and 15) that "Maeda does not disclose how to obtain servo signals in order to activate his lens activating means."

As further explained in the amendment filed July 29, 2002, inherency cannot be established absent a showing that something must absolutely occur, not simply that something might possibly occur. Thus, in order to establish inherency, the PTO reviewing court in In re Robertson, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) has noted that the evidence:

> [M]ust make clear that the missing descriptive matter is necessarily present in the thing described in the reference, that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.

Thus, before there can be said to be any inherency in focus correcting a lens position using drive signals derived from the actual up and down pit deviations, proof must be presented as this is not the standard as explained above.

Moreover, Claim 15 is specific to the driving of two lens actuators with two different drive frequencies, subject matter clearly not taught or suggested by Maeda.

Accordingly, for all the above-noted reasons, the rejection of base independent Claims 1, 15, and 22 as being anticipated by Maeda is respectfully traversed.

With regard to Claim 5 dependent upon Claim 1, Claim 19 dependent upon Claim 15, and Claim 26 dependent on Claim 22, each of these dependent claims clearly defines over anything reasonably taught or suggested by Maeda for the same reasons that the respective parent claim does. In addition, each of these dependent claims includes further features in addition to those recited by its respective independent claim, which are not taught or suggested by Maeda. Thus, dependent Claims 5, 19, and 26 are believed to patentably define over Maeda for this reason as well.

Turning to Claims 2 and 3, it is noted that these claims all depend on Claim 1 while Claims 16 and 17 depend on Claim 15 and Claims 23 and 24 depend on Claim 22. In addition, it is noted that Funada in no way cures any of the above-noted Maeda deficiencies. Accordingly, all of these dependent claims are believed to patentably define over Maeda considered alone or in any proper combination with Funada for at least the reasons that

respective parent Claims 1, 15, and 22 do. In addition, each of these dependent claims add further features not taught or suggested by Maeda and/or Funada considered alone or together in any proper combination. Therefore, these dependent claims are further considered to patentably define over Maeda and/or Funada considered alone or together in any proper combination because of these added features.

With further regard to Claims 6, 7, 20, 21, 27, and 28, it is noted that each of these claims depend from one of the above-noted independent Claims 1, 15, and 22 such that they clearly patentably define over Maeda for the same reasons that parent these parent independent claims do. Furthermore, as Sugiyama in no way cures the above-noted deficiencies in Maeda, Claims 6, 7, 20, 21, 27 and 28 are believed to clearly patentably define over Maeda taken alone or with Sugiyama in any proper combination for all the reasons discussed above as to these parent claims. In addition, each of Claims 6, 7, 20, 21, 27, and 28 further clearly patentably define over Maeda taken alone or in any proper combination with Sugiyama because of the features that each of these claims add to their respective independent base claim. Note that the added high and low band filters of these claims are used to provide envelope components to control up and down movements along the optical axis, not side to side movements for tracking control as taught by Sugiyama as to band pass filter 20, not defined to be either high or low by Sugiyama.

In light of the foregoing and as no other issues are believed to remain outstanding relative to this application, it is respectfully submitted that this application is clearly in condition for formal allowance and an early and favorable action to that effect is, therefore, respectfully requested.

Respectfully submitted,

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Audio Compact Disk - An Introduction

EE 498

ATTACHMENT

Professor Kelin J. Kuhn

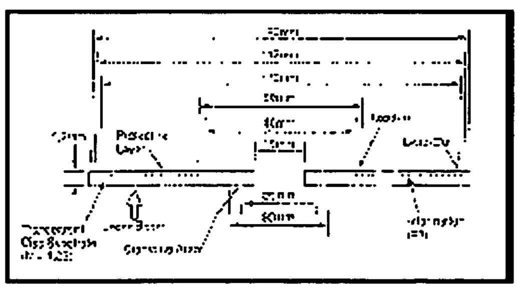
Two lectures of material

The conventional audio compact disk is a high density media for storing digitally sampled audio. A CD audio disk holds approximately 74 minutes of stereo music recorded with 16-bit resolution -- and incorporates a number of error reduction, detection and correction techniques.

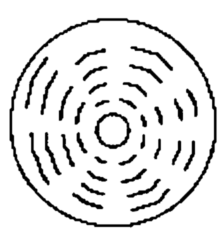
I. The disk itself

A. Size and overall construction

The CD disk is a 120 mm diameter disk of polycarbonate. The center contains a hole 15 mm in diameter. The innermost part of the disk does not hold data. The active data area starts at the 46 mm diameter location and ends at the 117 mm diameter location. The 46-50 mm range is the lead in area and the 116-117 range is the lead out area[1]. Disks are written from the center to the outside (this increases manufacturing yield, and also allows for changes in disk size).



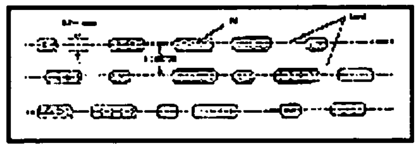
A CD disk contains a long string of pits written helically on the disk. The ***edges*** of the pits correspond to binary "1"s.



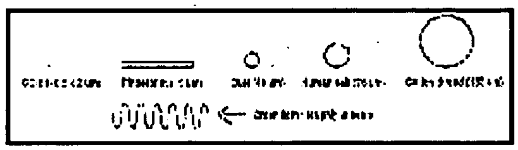
Each pit is approximately 0.5 microns wide and 0.83 microns to 3.56 microns long. (Remember that the wavelength of green light is approximately 0.5 micron) Each track is separated from the next track by

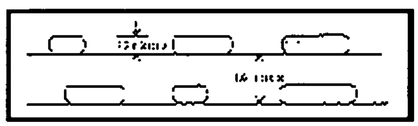
1.6 microns.

The area between the pits is termed "land". So, a highly magnified section of track might look something like:



Pits are formed in the polycarbonate disk by an injection molding process. As such, they represent some of the smallest mechanically fabricated objects made by humans. The width of a CD pit is approximately the wavelength of green light. The tracks are separated by approximately three times the wavelength of green light. Diffraction from these features (so very close to the wavelength of light) is what gives CD disks their beautiful colors.



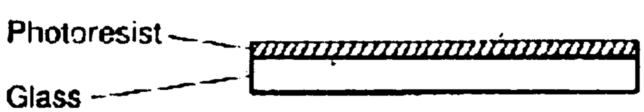


A thin layer (50-100 nm) of metal (aluminum, gold or silver) covers the pits. An additional thin layer (10-30 microns) of polymer covers the metal. Finally, a label is silk-screened on the top. Notice that the pits are far closer to the silk screened side of the disk (20 microns) than they are to the read-side of the disk (1.55 mm). Thus, it is easier to permanently damage a disk by scratching the top -- than the bottom!

B. Making the disk

The fabrication of a CD disk is a fascinating process. This process is discussed in some detail in The Compact Disk Handbook, Chapter 7 and only the high points are summarized here[2].

The process begins by making the "glass master". To do this, a glass plate about 300 mm in diameter is lapped flat and polished. The plate is coated with photoresist.



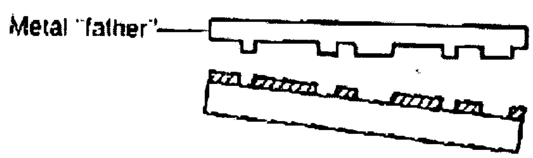
Resist coating

A mastering tape is made containing the information to be written on the disk. A laser then writes the pattern from the master tape into the photoresist.

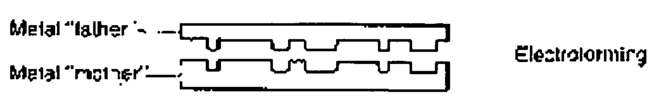
The photoresist is developed. A layer of metal (typically silver over a nickel flash) is evaporated over the photoresist. The master is then checked for accuracy by playing the disk.

The master is then subject to an electroforming process. In this electrochemical process, additional metal is deposited on the silver layer.

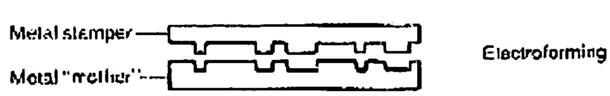
When the metal is thick enough (typically a few mm's) the metal layer is separated from the glass master. This results in a metal negative impression of the disk -- called a father.



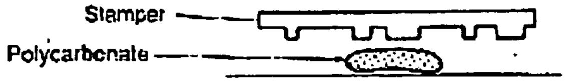
The electroplating process is then repeated on the father. This typically generates 3-6 positive metal impressions from the father before the quality of the father degrades unacceptably. These impressions are called "mothers".



The electroplating process is repeated again on the mothers. Each mother typically makes 3-6 negative metal impressions called sons or stampers. The sons are suitable as molds for injection molding.



Polycarbonate is used to injection mold the CD disks.



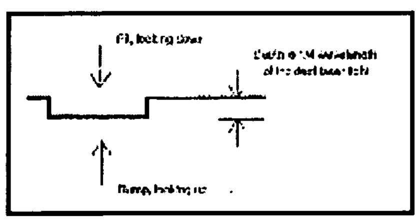
Once the disks are molded, a metal layer is used to coat the disks. Aluminum, gold, copper and silver are all reflective enough to be optically acceptable. Gold is typically too expensive and copper has a peculiar appearance. Thus, aluminum and silver are the most commonly used metals.

Following metal deposition, a thin plastic layer (1-30 microns) is spin-coated on over the metal. This be a nitrocellulose layer suitable for air drying, or an acrylic plastic that is cured in UV.

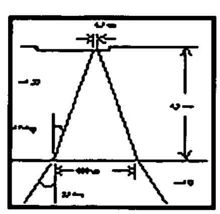
Finally, the logo and other information is silk screened on the top.

C. Reading the pits

The CD disk is actually read from the bottom. Thus, from the viewpoint of the laser beam reading the disk, the "pit" in the CD is actually a "bump".



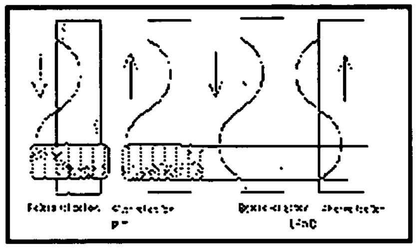
The polycarbonate itself is part of the optical system for reading the pits. The index of refraction of air is 1.0 while the index of refraction of the polycarbonate is 1.55. Laser light incident on the polycarbonate surface will be refracted at a greater angle into the surface. Thus, the original incident spot of around 800 microns (entering the polycarbonate) will be focused down to about 1.7 microns (at the metal surface). This is a major win, as it minimizes the effects of dust and scratches on the surface.



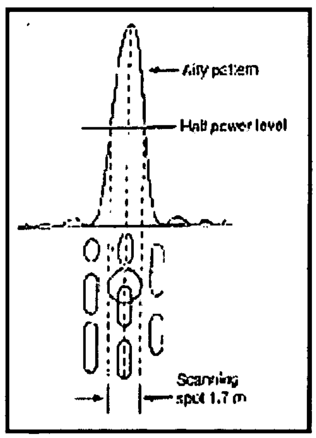
The laser used for the CD player is typically an AlGaAs laser diode with a wavelength in air of 780 nm. (Near infrared -- your vision cuts out at about 720 nm). The wavelength inside the polycarbonate is a

factor of n=1.55 smaller -- or about 500 nm.

The pit/bump is carefully fabricated so that it is a quarter of a wavelength (notice a wavelength INSIDE the polycarbonate) high. The idea here is that light striking the land travels 1/4 + 1/4 = 1/2 of a wavelength further than light striking the top of the pit. The light reflected from the land is then delayed by 1/2 a wavelength -- and so is exactly out of phase with the light reflected from the pit. These two waves will interfere destructively -- so effectively no light has been reflected.

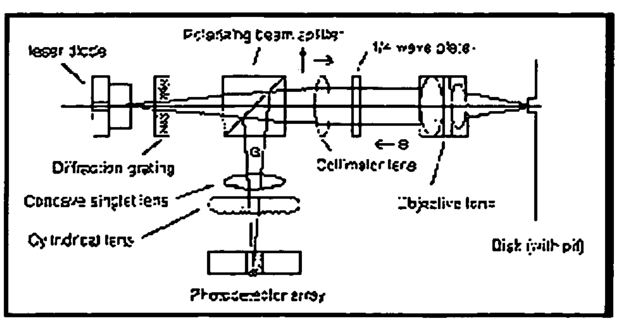


The spacing between pits is equally carefully selected. Recall from basic optics that the image of a beam passing through a round aperture will form a characteristic pattern called an Airy disk. The FWHM (full-width half-maximum) center of the Airy disk pattern is a spot about 1.7 um wide and falls neatly on top of the pit track. The nulls in the Airy pattern are carefully situated to fall on the neighboring pit tracks. This minimizes crosstalk from neighboring pits[3].



D. The optical train -- three beam pick-up

The most common optical train in modern CD players is the three beam pick-up, depicted below[4].



The light is emitted by the laser diode and enters a diffraction grating. The grating converts the light into a central peak plus side peaks. The main central peak and two side peaks are important in the tracking

mechanism.

The three beams go through a polarizing beam splitter. This only transmits polarizations parallel to the page. The emerging light (now polarized parallel to the page) is then collimated.

The collimated light goes through a 1/4 wave plate. This converts it into circularly polarized light.

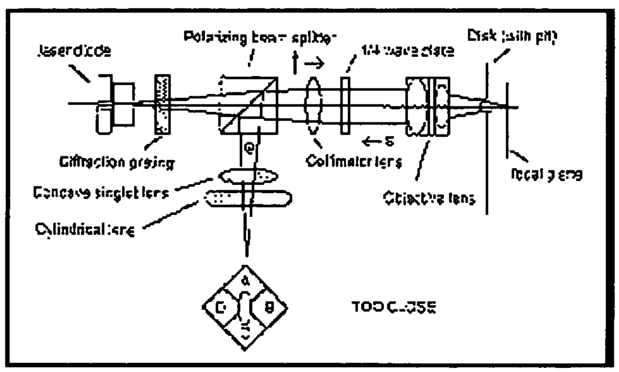
The circularly polarized light is then focused down onto the disk. If the light strikes "land" it is reflected back into the objective lens. (If the light strikes the pit, now a bump, it is not reflected.)

The light then passes through the 1/4 wave plate again. Since it is going the ***reverse direction***, it will be polarized ***perpendicular*** to the original beam (in other words, the light polarization is now vertical with respect to the paper).

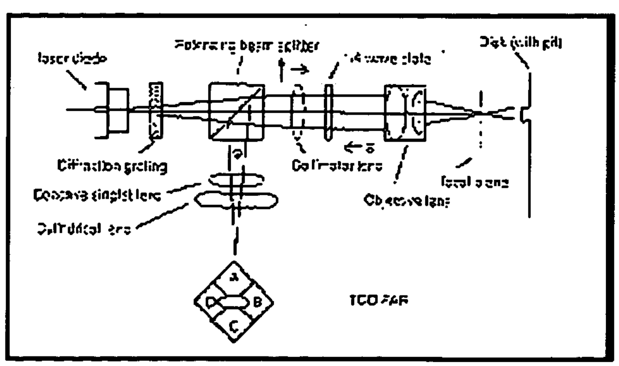
When the vertically polarized light hits the polarizing beam splitter this time, it will be reflected (not transmitted as before). Thus, it will reflect though the focusing lens and then the cylindrical lens and be imaged on the photodetector array. The cylindrical lens is important in the auto-focusing mechanism.

E. Three beam autofocus

If the objective lens is closer to the compact disk than the focal length of the object lens, then the cylindrical lens creates an elliptical image on the photodetector array.

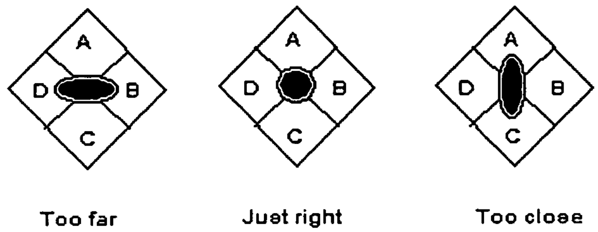


If the objective lens is further away from the compact disk than the focal length of the object lens, then the cylindrical lens again creates an elliptical image on the photodetector array. However, this elliptical image is perpendicular to first image.

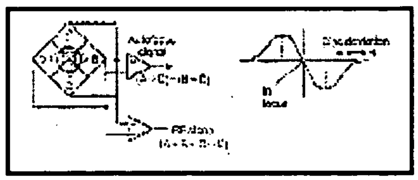


Of course, if the disk is right at the focal length of the objective lens, then the cylindrical lens does not

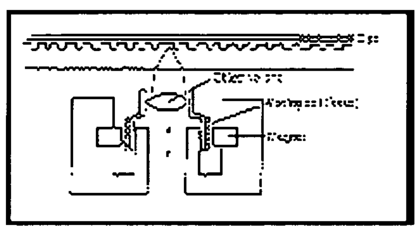
affect the image and it is perfectly circular.



So, if the disk is too far away -- then quadrants D and B will get more light than quadrants A and C. Similarly, if the disk is too close -- then quadrants A and C will get more light than D and B. A simple circuit generates an autofocus signal based upon the output of the photodetector[5].

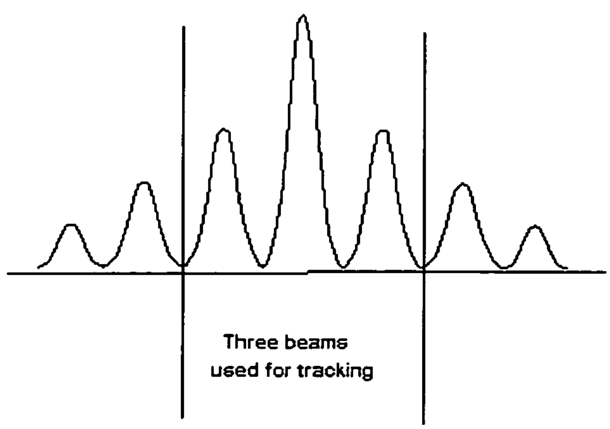


The output of this correction signal can be used to drive a simple auto-focus servo. A typical example of such a servo is illustrated below[6].

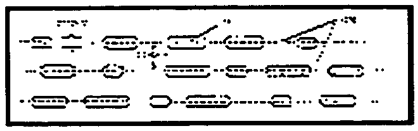


F. Three beam tracking

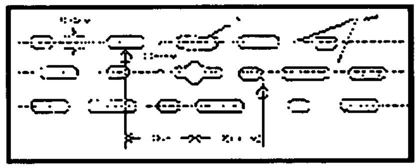
When the laser beam goes through the diffraction grating, it is split up into a central bright beam plus a number of side beams. The central beam and one beam on each side are used by the CD for the tracking system.



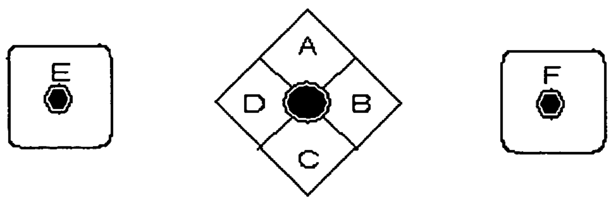
Consider a segment of the CD player containing several tracks.



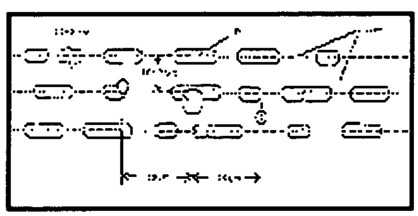
If the optical head is on track, then the primary beam will be centered on a track (with pits and bumps) and the two secondary beams will be centered on land. The three spots are deliberately offset approximately 20 microns with respect to each other.

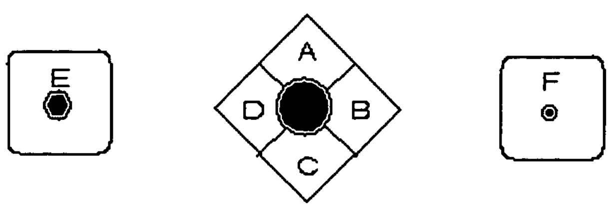


Two additional detectors are placed alongside the main quadrant detector in order to pick up these subsidiary beams. If the three beams are on track, then the two subsidiary photodetectors have equal amounts of light and will be quite bright because they are only tracking on land. The central beam will be reduced in brightness because it is tracking on both land and pits.



However, if the optical head is off track, then the center spot gets more light (because there are fewer pits off track) and the side detectors will be misbalanced.





Previous: HDTV

Next: Audio CD-IEC 908

Consumer Electronics Homepage